Canadian Centre for Occupational Health and Safety

Centre canadien d'hygiène et de sécurité au travail

BERYLLIUM DISEASE

A Summary of the Occupational Health Concern

P89 - 23E

BERYLLIUM DISEASE

A Summary of the Occupational Health Concern

Renzo Bertolini

Canadian Centre for Occupational Health and Safety

October 1989

90-03624/

BERYLLIUM DISEASE--A SUMMARY OF THE OCCUPATIONAL HEALTH CONCERN

This publication was prepared as a source of information for health and safety committees and others with an interest in understanding and reducing the occupational risk of beryllium disease.

Each publication produced by CCOHS undergoes several stages of review. As a part of this review, representatives from government, employers, and labour are requested to comment on draft copies of CCOHS documents for technical accuracy and readability.

Although every effort is made to ensure accuracy and completeness of the information, it is understood that CCOHS makes no warranty as to the accuracy or completeness of such informatoin and assumes no liability for any damages or loss suffered as a result of any inaccuracy or incompleteness there in.

In the interest of the widest possible dissemination of occupational health and safety information, CCOHS invites users to copy and distribute its publications. Appropriate written acknowledgment is requested and appreciated. CCOHS asks that users report the number of publications so distributed--please notify the Inquiries Service.

Cette publication est offerte en français sous le titre : Bérylliose -- Résumé des risques sur le plan professionnel.

CCOHS NUMBER P89-23E
ISBN 0-660-13358-X
DSS CATALOGUE NUMBER CC273-2/89-23E

Published 1989

---

250 Main Street East
Hamilton Ontario
L8N 1H6
416-572-2981
FAX 416-572-2206

CCOHS/CCHST

TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	INDUSTRIAL USES OF BERYLLIUM	1
3.	THE DISEASE	2
	Acute Beryllium Disease	2
	Chronic Beryllium Disease	2
4.	DIAGNOSIS AND TREATMENT	3
5.	PREVENTION	3
	FURTHER READING	5

CCOHS/CCHST

1. INTRODUCTION

Beryllium is a metal widely used in industry because of its important properties including light weight, high melting point, high strength, and good electrical conductivity. Exposure to the fumes and dusts of beryllium and its compounds or alloys causes various diseases that affect several organs of the body. Breathing in fumes or dusts of beryllium compounds may injure the lungs. Direct contact with beryllium fumes or dusts may injure the exposed areas of the body, such as the eyes or the skin. Beryllium may also affect such organs as the liver, the kidneys, the heart, the nervous system and the system that carries water and proteins to the blood (lymphatic system).

Workers who produce or use beryllium and its compounds and alloys, including those who melt, cast, grind, machine and drill materials containing beryllium are at risk of Beryllium disease. Ordinary handling of the pure metal or alloy stock has never been associated with diseases nor has exposure to the ores of beryllium.

2. INDUSTRIAL USES OF BERYLLIUM

The beryllium-containing materials that Canadian industry commonly use are the metal itself, beryllium oxide, and beryllium alloys. Industrial uses include the manufacture of thermal coating, nuclear reactors, rocket heat shields, brakes, x-ray tubes, and dental plates. The occupations listed below involve exposure to beryllium.

Industrial processes that use beryllium include:

- extraction of beryllium (smelting and refining)
- beryllium metallurgy (production of beryllium metal and compounds)
- precision machining
- nuclear applications
- microcircuits
- stamping/cutting
- die casting
- plastic moulding
- welding electrodes
- handling/assembly
- dental plates manufacturing
- thermal castings
- x-ray tube window manufacturing
- guidance and navigation systems manufacturing
- rocket parts, heat shields

3. THE DISEASE

There are various diseases that may develop from exposure to the fumes and dusts from beryllium and its compounds and alloys. These diseases are grouped into acute and chronic.

Acute Beryllium Disease

Acute diseases develop after a short and heavy exposure and usually last for less than one year. Acute beryllium disease may take several forms.

Contact dermatitis is an inflammation of the skin, causing itching, redness, swelling, and blisters. These symptoms appear on the exposed areas of the body, especially the face, neck, arms, and hands. Contact dermatitis usually improves a few weeks after exposure ends. Skin effects also develop if beryllium penetrates into cuts or scratches. Beryllium particles must be removed from a wound if it is to heal properly.

The membrane that covers the front of the eye can become inflamed in association with dermatitis. Splashes of beryllium solutions may also burn the eyes causing fluid accumulation and reddening around the eyes.

Nasopharyngitis is an inflammation of the nose and throat. Symptoms include pain and swelling. Signs include bleeding of the nose. This condition clears up three to six weeks after exposure ends.

Tracheobronchitis is an inflammation of the windpipe and the airways beyond it. Symptoms are coughing and discomfort, and tightness of the chest. Recovery takes about one month.

Pneumonitis is an inflammation of the lungs confined to the walls of the air sacs. Pneumonitis is the most serious of the acute effects from beryllium exposure. It varies in severity and can result in death. But fatal cases are rare and recovery is usually complete in about six months. Symptoms are coughing, breathing difficulties, tightness of the chest, appetite and weight loss, and general weakness and tiredness.

According to the United States Beryllium Case Registry, established in 1952, about 17 percent of patients with acute disease developed chronic disease. It is unknown why chronic disease developed in persons who have had previous acute disease.

Chronic Beryllium Disease

Chronic beryllium disease develops after months or years of exposure to beryllium. The period between first exposure and appearance of the disease is 10 to 15 years. The disease may develop while the individual is still exposed to beryllium or it may occur up to 25 years after the last exposure.

Chronic beryllium disease primarily affects the lungs. But it may also affect other organs because the blood transports beryllium throughout the body. The mechanism of beryllium disease is not absolutely known. Most likely, once in the body, beryllium combines with certain proteins, causing the release of toxic substances. These are responsible for the lesions seen in the lungs. Certain cells form masses of tissue called granulomas in response to beryllium. Granulomas mark chronic beryllium disease and are typically found in the lungs. But granulomas may also occur in the skin, liver, spleen, kidney, bone, nervous system, skeletal muscles, lymph glands and the wall of the heart.

Symptoms of chronic beryllium disease are breathing difficulties, coughing, chest pain, and general weakness. Signs include enlargement of the liver, spleen and right heart, and kidney stones. The course of chronic beryllium disease varies. Some affected people may have few or no symptoms at all for many years followed by eventual deterioration.

Animals exposed to beryllium have developed cancer of the lungs and bones. But it is unclear if beryllium causes cancer in humans. The International Agency for Research on Cancer (IARC) classifies beryllium as a group 2A carcinogen: probably causes cancer in humans.

4. DIAGNOSIS AND TREATMENT

Diagnosis and evaluation of acute beryllium disease requires the identification of the conditions of exposure through an analysis of the victim's employment history.

The diagnosis of chronic beryllium disease is based upon criteria established by the Beryllium Case Registry. These include the evidence of significant beryllium exposure, abnormalities in the chest x-ray and lung function tests, and the presence of beryllium in lung or other tissue.

Treatment for acute beryllium disease includes removal from exposure, bed rest, administration of oxygen and corticosteroids, which prevent inflammation. The only available therapy for chronic beryllium disease is corticosteroids. Lifetime therapy is usually required. Victims who stopped treatment have experienced aggravated symptoms.

5. PREVENTION

Workplaces need to identify sources of beryllium. WHMIS requires the identification of beryllium (if more than 0.1 percent) other than in a manufactured article or in hazardous waste.

Very stringent measures are required to prevent possible exposure to beryllium. They are:

- process enclosure
- automation of the work procedures
- local exhaust ventilation systems
- good housekeeping
- protective clothing
- convenient washing facilities
- good sanitation practices
- education

Enclosing processes separates workers from harmful substances. Adequate local exhaust systems prevent toxic substances from escaping into the workroom. Workers should use wet processes, such as cutting fluids and wet grinding, honing and polishing. Workplaces need light and sound warning devices attached to detectors in areas where there is a potential of massive contamination. Air from the area ventilation and local exhaust system should be exhausted to the atmosphere through high-efficiency filtration equipment. Workplaces need proper procedures for the cleaning of air-cleaning devices.

Good housekeeping includes proper storage of substances, frequent disposal of waste, prompt spill clean-up, periodic maintenance of the equipment and no dry sweeping.

Respiratory protective devices and protective clothing can help reduce exposure. If workers must use respirators for breathing protection, they should have a written respiratory protection program to follow. Guidance for developing a program can be found in the current CSA standard Z94-.4 "Selection, Care, and Use of Respirators." Workplaces must follow all legal requirements for respirator use and approval. These may vary between jurisdictions in Canada. Workers should also use protective clothing such as coveralls, headgear, and shoes. They should use a vacuum, not compressed air, to remove the dust from work clothes. Workers should remove contaminated clothing in change rooms only.

Workplaces need to conveniently locate washrooms, toilets, showers, and locker facilities.

Separate locker facilities will ensure that work clothes do not contaminate street clothes. The workplace should also provide educational programs to inform workers about the nature of substances they are exposed to, and how to work safety.

FURTHER READING

Cotes, J.E. et al. A long-term follow-up of workers exposed to beryllium. British Journal of Industrial Medicine. Vol. 40, no. 1 (1983) p. 13-21.

Criteria for a recommended standard: occupational exposure to beryllium. Cincinnati: National Institute for Occupational Safety and Health, 1972.

Cullen, M.R. et al. Chronic beryllium disease in a precious metal refinery: clinical epidemiologic and immunologic evidence for continuing risk from exposure to low level beryllium fume. American Review of Respiratory Disease. Vol. 135, no. 1 (1987) p. 201-208.

DeNardi, J.M. et al. Berylliosis. Archives of Industrial Hygiene and Occupational Medicine. Vol. 8, no. 1 (1953) p. 1-24.

Eisenbud, M. et al. Epidemiological aspects of beryllium-induced nonmalignant lung disease: a 30-year update. Journal of Occupational Medicine. Vol. 25, no. 3 (1983) p. 196-202.

Hardy, H.L. Beryllium disease: a clinical perspective. Environmental Research. Vol. 21 (1980) p. 1-9.

Kriebel, D. et al. Beryllium exposure and pulmonary function: a cross sectional study of beryllium workers. British Journal of Industrial Medicine. Vol. 45, no. 3 (1988) p. 167-173.

Kriebel, D. et al. The pulmonary toxicity of beryllium. American Review of Respiratory Disease. Vol. 137, no. 2 (1988) p. 464-473.

Occupational respiratory diseases. Editor, J.A. Merchant. Washington: National Institute for Occupational Safety and Health, 1986. p. 385-399.

Pneumoconioses. A.L. Lanza, editor. New York: Grune and Stratton, 1963. p. 73-102.

Some metals and metallic compounds. (IARC monographs on the evaluation of the carcinogenic risk of chemicals to humans, Vol. 23) Lyon: International Agency for Research on Cancer, 1980. p. 143-204.